

WHAT IS CLAIMED IS:

1. A method of calculating $x^{M/N}$, wherein x has a value in a range $(0, x_{\max}]$ and M and N are integers, comprising the steps of:
 - partitioning the range $(0, x_{\max}]$ into a plurality of K number of intervals
- 5 [$B^k, B^{(k+1)N}$], where $B > 1$ and $k = -1, 0, 1 \dots K$;
- 10 determining the interval $[B^k, B^{(k+1)N}]$ in which x falls and deriving a value of k therefrom;
- 15 dividing x by a normalization factor B^{kN} to obtain a normalized value x' ;
- 20 computing a value of $x'^{M/N}$ for the normalized value x' ; and renormalizing by multiplying $x'^{M/N}$, by B^{kM} to obtain $x^{M/N}$.
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75
- 80
- 85
- 90
- 95

3. The method of Claim 1 wherein $x^{M/N}$ is calculated in binary form and B is equal to 2.

4. The method of Claim 1 wherein said step of calculating comprises the step
5 of performing a series expansion to calculate the value $x' (M/N)$ for the normalized
value x' .

5. The method of Claim 2 and further comprising the step of interpolating
between the value $x' (M/N)$ retrieved for a first quantized approximation of the
10 normalized value x' and a second quantized approximation of the value of $x' (M/N)$
retrieved for a second value of x' .

6. The method of Claim 1 wherein the method is implemented in a program
executed by a digital signal processor.

15 7. The method of Claim 1 wherein said steps are performed using fixed point
operations.

8. A method of calculating $x^{M/N}$, x having a range and M and N are integers, comprising the steps of:

partitioning the range of x into selected number of intervals;

determining the interval into which x falls;

5 normalizing x with a normalization factor calculated for the interval into which x falls to obtain a normalized value x' within a normalized range;

determining a value for $x' (M/N)$ from x' within the normalized range; and

10 renormalizing by multiplying $x' (M/N)$ by a renormalization factor calculated for the interval in which x falls obtain $x^{M/N}$.

9. The method of Claim 8 wherein said step of determining comprises the substeps of:

storing a plurality of values of $x' (M/N)$ over the normalized range in a table;
and

15 retrieving a value of $x' (M/N)$ from the table for the normalized value x'

20 10. The method of Claim 8 wherein the normalization factor is B^{Kn} where B is the base in which $x^{M/N}$ is calculated and k is an index between 0 and $K-1$ of the interval into which x falls, the range of x divided into K number of intervals.

11. The method of Claim 8 wherein the renormalization factor is B^{kM} .

12. The method of Claim 9 and further comprising the step of retrieving a second value $x''^{(M/N)}$ corresponding to a second normalized value x'' and
5 interpolating between the retrieved value of $x'^{(M/N)}$ and the second retrieved value $x''^{(M/N)}$.

13. The method of Claim 12 wherein said step of interpolating comprises the step of linearly interpolating in accordance with the formula:

10
$$x'^{(M/N)} = \alpha(x'^{(M/N)}) + (1 - \alpha)x''^{(M/N)}$$

where α is an interpolation factor.

14. The method of Claim 8 wherein $M > N$ and the method comprises the steps of factoring $x^{M_1} * x^{(M_2/N)}$, where $M = M_1*N + M_2$ and $M_2 < N$, and
15 calculating $x^{(M_2/N)}$.

15. The method of Claim 8 wherein said steps of normalizing and renormalizing are implemented in fixed point operations.

16. A method of calculating a value of a function $f(x)$ for a binary input value x within an un-normalized range comprising the steps of:

shifting a received input value x by a selected number of places in a selected direction to normalize the value of x to a normalized value x' in the
5 normalized range;

calculating a value $f(x')$ for the function $f(x)$ for data point x' in the normalized range; and

shifting the calculated value of x' in a selected direction to obtain the value of $f(x)$ for the input value x .

10

17. The method of Claim 16 wherein $f(x) = x^{M/N}$, where M and N are integers.

18. The method of Claim 17 wherein the normalized range is selected to be
[1, B^N].

15

19. The method of Claim 16 wherein said step of calculating comprises the substeps:

storing values $f(x')$ of the function $f(x)$ for a set of normalized values x' over a selected normalized range in a table; and

20

indexing the table with part of x' and retrieving the value of $f(x')$.

ATTORNEY DOCKET NO.
1075-CA

PATENT

42

20. The method of Claim 19 wherein said step of calculating further comprises the substeps of

retrieving a second value of $f(x'')$ from the table for interpolation;

linearly interpolating between the value and second value of $f(x'')$ using a fractional part of x' as an interpolation factor to obtain an interpolated value of x' ;

5

21. The method of Claim 19 wherein said step of calculating comprises the step of calculating a value of $f(x'')$ using a series expansion.

WSM Docket No.
2836- P125US

22. A signal processing system comprising:
processing circuitry for obtaining a value for the function $f(x)$ for an input
data point x taken over an unnormalized range and operable to:
shift the input data point x by a selected number of places to normalize the
5 value of x to a normalized data point x' in the normalized range;
calculate a value of $f(x')$; and
shift the value of $f(x')$ a selected number of places to renormalize and
obtain a result of $f(x)$ over the unnormalized range for the input value x .
- 10 23. The signal processing system of Claim 22 wherein the signal processing
circuitry operates on fixed point values of x and x' .
- 15 24. The signal processing system of Claim 22 wherein said processing
circuitry comprises a digital signal processor.
- 20 25. The signal processing system of Claim 24 wherein said digital signal
processor forms a part of an audio data processing device
26. The signal processing system of Claim 25 wherein said digital signal
processor forms a part of a dual signal processor audio data processing device.